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PATENT                                                  Application Number 09/921,993

### IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

**In re application of:** Scarborough et al.
**Application No.** 09/921,993
**Filed:** August 2, 2001                    Sent via Facsimile to: 571-270-2123
**Confirmation No.** 6882
**For:**   DEVELOPMENT OF ELECTRONIC
           EMPLOYEE SELECTION SYSTEMS AND
           METHODS
**Examiner:** Lut Wong
**Art Unit:** 2129
**Attorney Reference No.** 5437-60780-01

### PROPOSED AMENDMENT

Applicants thank the Examiner for suggestions regarding moving the application forward. Applicants propose the following amendments to place the application in condition for allowance. The Examiner indicated that only independent claims 1 and 2 would be examined. Before canceling the other independent claims (15, 23, 25, 37, 40, and 41), Applicants require a written Restriction.

Please note that Applicants have amended claims 1 and 2 by removing "comprising tenure." Applicants believe the claims are patentable without such language.

Finally, Applicants propose adding claim 51, a product by process claim that mimics the language of claim 1.

## Claims

1.     (**Currently Amended**)  A method of constructing a model operable to generate one or more job performance criteria predictions based on input pre-hire information, the method comprising:

electronically collecting pre-hire information from a plurality of applicants wherein at least some of the pre-hire information is collected from at least one of the applicants who responds directly on an electronic device to provide pre-hire applicant responses to questions;

collecting post-hire information for the applicants based on job performance of the applicants after hire;

via information-theoretic feature selection, choosing questions from the pre-hire information as features for which respective pre-hire applicant responses serve as inputs to the model, wherein the information-theoretic feature selection comprises identifying at least one higher-order interaction comprising a set of a plurality of questions having higher predictive power than a sum of predictive powers of individual questions in the set, **wherein the higher-order interaction exhibits a synergy between the set of the plurality of questions having higher predictive power**; ~~and~~

from the pre-hire information and the post-hire information, training an artificial intelligence-based predictive model in a computer-readable medium with observed pre-hire applicant responses for the chosen features, wherein the artificial intelligence-based

predictive model is operable to generate one or more job performance criteria predictions

~~comprising tenure~~ based at least on input pre-hire information from new applicants

corresponding to the chosen features, whereby the one or more job performance criteria

predictions are usable as a basis for a hiring recommendation or other employee selection

information;

    **deploying the model, wherein deploying comprises converting the model into command code and providing an operational applicant processing system; and**

    **conducting performance tuning for the model, wherein performance tuning comprises continuing data collection, monitoring sample size as incoming data accumulates, and repeating feature selection.**

    2.    (Currently Amended)  A computer-readable medium comprising computer-executable instructions for performing a method of constructing a model operable to generate one or more job performance criteria predictions based on input pre-hire information, the method comprising:

    electronically collecting pre-hire information from a plurality of applicants wherein at least some of the pre-hire information is collected from at least one of the applicants who responds directly on an electronic device to provide pre-hire applicant responses to questions;

    collecting post-hire information for the applicants based on job performance of the applicants after hire;

via information-theoretic feature selection, choosing questions from the pre-hire information as features for which respective pre-hire applicant responses serve as inputs to the model, wherein the information-theoretic feature selection comprises identifying at least one higher-order interaction comprising a set of a plurality of questions having higher predictive power than a sum of predictive powers of individual questions in the set**, wherein the higher-order interaction exhibits a synergy between the set of the plurality of questions having higher predictive power**; ~~and~~

from the pre-hire information and the post-hire information, training an artificial intelligence-based predictive model with observed pre-hire applicant responses for the chosen features, wherein the artificial intelligence-based predictive model is operable to generate one or more job performance criteria predictions ~~comprising tenure~~ based at least on input pre-hire information from new applicants corresponding to the chosen features**;**

**deploying the model, wherein deploying comprises converting the model into command code and providing an operational applicant processing system; and**

**conducting performance tuning for the model, wherein performance tuning comprises continuing data collection, monitoring sample size as incoming data accumulates, and repeating feature selection**.

3.      (Canceled)

4.      (Canceled)


5.      (Original)  The method of claim 1 further comprising:

limiting the applicants for the model to those with a particular occupation; and

constructing the model as an occupationally-specialized model.


6.      (Original)  The method of claim 1 wherein the model accepts one or more

inputs, the method further comprising:

identifying in the pre-hire information one or more characteristics that are

ineffective predictors; and

omitting the ineffective predictors as inputs to the model.


7.      (Original)  The method of claim 1 wherein the pre-hire information

comprises one or more characteristics, the method further comprising:

identifying in the pre-hire information one or more characteristics that are

ineffective predictors; and

providing an indication that the characteristics no longer need to be collected.


8.      (Previously Presented)  The method of claim 1 wherein job performance

criteria predictions comprise a prediction indicating whether a job candidate will be

voluntarily terminated.

9.      (Previously Presented)  The method of claim 1 wherein job performance criteria predictions comprise a prediction indicating whether a job candidate will be eligible for rehire after termination.

10.     (Previously Presented)  The method of claim 1 wherein the pre-hire information comprises one or more characteristics, the method further comprising:

identifying in the pre-hire information one or more characteristics that are ineffective predictors;

responsive to identifying the ineffective predictors, collecting new pre-hire information not including the ineffective predictors; and

building a refined model based on the new pre-hire information.

11.     (Original)  The method of claim 10 further comprising:

adding one or more new characteristics to be collected when collecting the new pre-hire information.

12.     (Original)  The method of claim 11 further comprising:

evaluating the effectiveness of the new characteristics.

13.     (Canceled)

14.    (Canceled)


15.    (Previously Presented)  A method for constructing an artificial intelligence-based employment selection process based on pre-hire information comprising personal employee characteristics and post-hire information comprising employee job performance observation information, the method comprising:

via information-theoretic feature selection, choosing questions from the pre-hire information as chosen features for which respective pre-hire applicant responses serve as inputs to predictive artificial models, wherein the information-theoretic feature selection comprises identifying at least one higher-order interaction comprising a set of a plurality of questions having higher predictive power than a sum of predictive powers of individual questions in the set;

generating a plurality of predictive artificial intelligence models accepting the chosen features as inputs, based on the pre-hire and post-hire information, wherein at least two of the artificial intelligence models are of different feed-forward types and different architectures;

testing effectiveness of the models to select an effective model; and

applying the effective model to predict post-hire information not yet observed, whereby the post-hire information not yet observed that is predicted by the effective

model can be a basis for a hiring recommendation or other employee selection

information.


     16.    (Canceled)


     17.    (Previously Presented)  The method of claim 15 wherein at least one of the

models is an expert system.


     18.    (Canceled)


     19.    (Canceled)


     20.    (Canceled)


     21.    (Original)  The method of claim 15 further comprising:

identifying at least one of the models as exhibiting impermissible bias; and

avoiding use of the models exhibiting impermissible bias.


     22.    **(Canceled)**

23.    (Previously Presented) A computer-implemented method of refining an artificial-intelligence based employee performance selection system, the method comprising:

collecting information via an electronic device presenting a set of questions to employment candidates, wherein the questions are stored in a computer-readable medium;

collecting post-hire information for the employment candidates based on job performance of the employment candidates after hire, wherein collecting post-hire information comprises receiving payroll information for the employment candidates via a network, determining a termination date for an employment candidate from the payroll information received via the network, and determining tenure of the employment candidate by comparing the termination date with a hiring date of the applicant;

testing effectiveness of at least one of the questions in predicting tenure, wherein testing effectiveness comprises considering various sets of permutations of predictive items comprising the at least one of the questions, wherein the at least one of the questions alone is ineffective but is effective in combination with one or more other items; and

responsive to determining the question is ineffective in predicting tenure, deleting the question from the computer-readable medium.

24.    (Canceled)

25.    (Previously Presented) A computer-readable medium comprising a predictive model, the model comprising:

inputs for accepting one or more characteristics based on pre-hire information for a job applicant, wherein at least one of the inputs is chosen via information-theoretic feature selection and corresponds to a question for which pre-hire applicant responses have been collected, wherein the information-theoretic feature selection comprises identifying at least one higher-order interaction comprising a set of a plurality of questions having higher predictive power than a sum of predictive powers of individual questions in the set; and

one or more predictive outputs indicating one or more predicted job effectiveness criteria based on the inputs,

wherein the predictive model is an artificial intelligence-based model constructed from pre-hire data electronically collected from a plurality of employees and post-hire data, and the model generates its predictive outputs based on the similarity of the inputs to pre-hire data collected for the plurality of employees and their respective post-hire data; and

wherein the one or more predicted job effectiveness criteria comprise at least one selected from the group consisting of:

whether the job applicant will be involuntarily terminated, and whether the job applicant will be eligible for rehire upon termination.

26.     (Original) The computer-readable medium of claim 25 wherein the predictive model comprises a predictive output indicating a rank for the job applicant.

27.     (Original)  The computer-readable medium of claim 26 wherein the rank is relative to other applicants.

28.     (Original)  The computer-readable medium of claim 26 wherein the rank is relative to the plurality of employees.

29.     (Original)  The computer-readable medium of claim 25 wherein the predictive model comprises a predictive output indicating probability of group membership for the job applicant.

30.     (Original)  The computer-readable medium of claim 25 wherein the predictive model comprises a predictive output indicating predicted tenure for the job applicant.

31.     (Canceled)

32.     (Original) The computer-readable medium of claim 25 wherein the predictive model comprises a predictive output indicating predicted number of accidents for the job applicant.


33.     (Original) The computer-readable medium of claim 25 wherein the predictive model comprises a predictive output indicating whether the applicant will be involuntarily terminated.


34.     (Original) The computer-readable medium of claim 25 wherein the predictive model comprises a predictive output indicating whether the applicant will be eligible for rehire after termination.


35.     (Canceled)


36.     (Canceled)

37.    (Previously Presented)  A computer-readable medium comprising a refined predictive artificial intelligence-based model, the model comprising:

inputs for accepting one or more characteristics based on pre-hire information for a job applicant, wherein at least one of the inputs is chosen via information-theoretic feature selection and corresponds to a question for which pre-hire applicant responses have been collected, wherein the information-theoretic feature selection comprises identifying at least one higher-order interaction comprising a set of a plurality of questions having higher predictive power than a sum of predictive powers of individual questions in the set; and

one or more predictive outputs indicating one or more predicted job effectiveness criteria based on the inputs;

wherein the one or more predictive outputs are configured to predict whether the job applicant will be involuntarily terminated or whether the job applicant will be eligible for rehire upon termination, and

wherein the predictive model is constructed from pre-hire data electronically collected from a plurality of employees and post-hire data, wherein the pre-hire data is based on a question set refined by having identified and removed one or more questions as ineffective.

38.    (Canceled)

    39.    (Canceled)

    40.    (Previously Presented)  An apparatus for assisting in determining the suitability of an individual for employment by an employer, the apparatus comprising:

    a computer-readable medium comprising a predictive model comprising:

    inputs for accepting one or more characteristics based on pre-hire information for a job applicant, wherein at least one of the inputs is chosen via information-theoretic feature selection and corresponds to a question for which pre-hire applicant responses have been collected, wherein the information-theoretic feature selection comprises identifying at least one higher-order interaction comprising a set of a plurality of questions having higher predictive power than a sum of predictive powers of individual questions in the set; and

    one or more predictive outputs indicating one or more predicted job effectiveness criteria based on the inputs, wherein the predictive model is an artificial intelligence-based model constructed from pre-hire data electronically collected from a plurality of employees and post-hire data, and the model generates its predictive outputs based on the similarity of the inputs to pre-hire data collected for the plurality of employees and their respective post-hire data; wherein the one or more predicted job effectiveness criteria comprise at least one selected from the group consisting of: whether the job applicant will be involuntarily terminated, and whether the job applicant will be eligible for rehire upon termination;

electronic data interrogator means for presenting a first set of a plurality of means for questioning to the individual;

electronic answer capturer means for electronically storing answers by the individual to at least a selected plurality of the first set of means for questioning presented to the individual;

electronic predictor means responsive to the stored answers and for predicting at least one post-hire outcome if the individual were to be employed by the employer, the predictor providing a prediction of the outcome based upon correlations of the stored answers with answers to sets of means for questioning by other individuals for which post-hire information has been collected;

electronic results provider means for providing an output indicative of the outcome to assist in determining the suitability of the individual for employment by the employer.


41.    (Previously Presented)  An apparatus for assisting in determining the suitability of an individual for employment by an employer, the apparatus comprising:

an electronic device for presenting a first set of a plurality of means for questioning to the individual;

means for electronically storing answers by the individual to at least a selected plurality of the first set of means for questioning presented to the individual;

means responsive to the stored answers and for predicting at least one post-hire outcome if the individual were to be employed by the employer, the predictor providing a prediction of the outcome based upon correlations of the stored answers with answers to sets of means for questioning by other individuals for which post-hire information has been collected; and

means for providing an output indicative of the outcome to assist in determining the suitability of the individual for employment by the employer,

wherein the apparatus comprises a predictive model comprising:

inputs for accepting one or more characteristics based on pre-hire information for a job applicant, wherein at least one of the inputs is chosen via information-theoretic feature selection and corresponds to a question for which pre-hire applicant responses have been collected, wherein the information-theoretic feature selection comprises identifying at least one higher-order interaction comprising a set of a plurality of questions having higher predictive power than a sum of predictive powers of individual questions in the set; and

one or more predictive outputs indicating one or more predicted job effectiveness criteria based on the inputs,

wherein the predictive model is an artificial intelligence-based model constructed from pre-hire data electronically collected from a plurality of employees and post-hire data, and the model generates its predictive outputs based on the similarity of the inputs to pre-hire data collected for the plurality of employees and their respective post-hire data; and

wherein the one or more predicted job effectiveness criteria comprise at least one selected from the group consisting of:

whether the job applicant will be involuntarily terminated, and whether the job applicant will be eligible for rehire upon termination.


42.     (Canceled)


43.     (Previously Presented)  The computer-readable medium of claim 37 wherein the ineffective questions are identified via an information transfer technique comprising:

considering various sets of permutations of answers to questions;

evaluating whether the sets of permutations are effective; and

determining whether an answer to a question is not in any effective set of permutations.

44.     (Previously Presented) The method of claim 46 wherein collecting post-hire information further comprises:

tracking whether the applicant has been dropped from payroll.

45.     (Previously Presented)  The method of claim 21 wherein:

the identifying comprises comparing across gender, ethnicity, or age differences.

46.     (Previously Presented) The method of claim 1 wherein:

collecting post-hire information comprises receiving payroll information for the applicants via a network, determining a termination date for an applicant from the payroll information received via the network, and determining tenure of the applicant by comparing the termination date with a hiring date of the applicant.

47.     (Previously Presented) The method of claim 1 wherein:

the set of the plurality of questions having higher predictive power than the sum of predictive powers of individual questions in the set comprises at least one biodata question and at least one psychometric question.

48.     (Previously Presented) The method of claim 1 wherein identifying at least one higher-order interaction comprises:

generating an approximation of an optimal subset of quetsions for use as input features for the model.

49.     (Previously Presented) The method of claim 48 wherein generating an approximation of an optimal subset of questions comprises:

determining a union of a set of questions appearing in predictive transmissions of greatest magnitude.

50.     (Previously Presented) The method of claim 48 wherein generating an approximation of an optimal subset of questions comprises:

from a set of transmissions $T_k$, choosing $m$ unique transmissions of greatest magnitude as a base set for higher-order transmissions;

generating $T'_{k+1}$, by adding questions to members of $T_k$, that generate a set $T'_{k+1}$ with largest transmission values; and

taking a union of questions appearing in the unique transmissions of greatest magnitude, wherein the union approximates the optimal subset of questions.

51.    (New)  One or more computer-readable storage media having stored thereon an executable model operable to generate one or more job performance criteria predictions based on input pre-hire information, the model constructed via a method comprising:

electronically collecting pre-hire information from a plurality of applicants wherein at least some of the pre-hire information is collected from at least one of the applicants who responds directly on an electronic device to provide pre-hire applicant responses to questions;

collecting post-hire information for the applicants based on job performance of the applicants after hire;

via information-theoretic feature selection, choosing questions from the pre-hire information as features for which respective pre-hire applicant responses serve as inputs to the model, wherein the information-theoretic feature selection comprises identifying at least one higher-order interaction comprising a set of a plurality of questions having higher predictive power than a sum of predictive powers of individual questions in the set, wherein the higher-order interaction exhibits a synergy between the set of the plurality of questions having higher predictive power;

from the pre-hire information and the post-hire information, training an artificial intelligence-based predictive model in a computer-readable medium with observed pre-hire applicant responses for the chosen features, wherein the artificial intelligence-based predictive model is operable to generate one or more job performance criteria predictions

based at least on input pre-hire information from new applicants corresponding to the

chosen features, whereby the one or more job performance criteria predictions are usable

as a basis for a hiring recommendation or other employee selection information;

deploying the model, wherein deploying comprises converting the model into

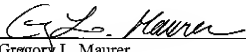command code and providing an operational applicant processing system; and

conducting performance tuning for the model, wherein performance tuning

comprises continuing data collection, monitoring sample size as incoming data

accumulates, and repeating feature selection.

Respectfully submitted,

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